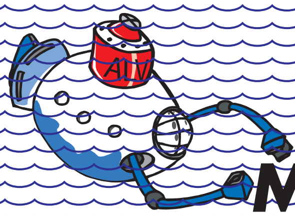


Mapping Seamounts in the Gulf of Alaska

Focus
Physical description of seamounts in the Axial-Cobb-Eikelberg-Patton chain

Grade Level
7-8

Focus Question
How can seamounts in the Axial-Cobb-Eikelberg-Patton chain be mapped to facilitate their exploration with a manned submersible?

Learning Objectives
Students will be able to describe major topographic features on the Patton Seamount.

Students will be able to interpret two-dimensional topographic data.

Students will be able to create a three-dimensional model of landforms from two-dimensional topographic data.

Materials
- ❒ 12 copies of Patton Seamount Bathymetry, enlarged 288% (the color version of this map can be downloaded from http://www.uaf.edu/seagrant/NewsMedia/01ASJ/topo1.pdf)
- ❒ 12 11 x 17 pieces of cardboard, 1/16-inch thick
- ❒ Glue, preferably spray type used for mounting photographs
- ❒ Sharp scissors or X-Acto knives for cutting cardboard

Audio/Visual Materials
(Optional) Computer video of simulated fly-around of the Patton Seamount; download from
http://ridge.coas.oregonstate.edu/rkeller/Fly_around.mov

Teaching Time
Two 45-minute periods, including evaluation

Seating Arrangement
Groups of one to three students

Maximum Number of Students
36

Key Words
Seamount
Bathymetry
Transducer
Backscatter
Topographic contour

Background Information
Seamounts (also called guyots) are undersea mountains that rise from the ocean floor, often with heights of 3,000 m (10,000 ft) or more. Compared to the surrounding ocean waters, seamounts have high biological productivity, and provide habitats for a variety of plant, animal, and microbial species. Numerous seamounts have been discovered in the Gulf of Alaska. Many of these seamounts occur in long chains that parallel the west coast of the U.S. and Canada. One of the longest chains, known as the Axial-Cobb-Eikelberg-Patton chain, is being intensively studied by the Ocean Exploration 2002 Gulf of Alaska Expedition.

Geologists and biologists will use the manned submersible Alvin to take samples and make observations to discover what animals and plants inhabit the seamounts, how the seamounts were formed, and what clues they may provide about global climate change. But underwater time is severely limited, and every dive must be carefully planned to ensure that the submersible can go directly to places on the seamounts that are most likely to provide the information the scientists need. So before the dives can begin, the seamounts must be mapped to locate the best places to collect samples and to identify unusual features that may need additional study.

The first order of business for scientists on the R/V *Atlantis* will be to use multibeam swath bathymetry to create detailed pictures of the seamounts they want to study. Multibeam swath bathymetry (also called high-resolution multibeam mapping) uses a transducer (a sort of combination microphone/loudspeaker) mounted on the ship's hull to send out pulses of sound in a fan-shaped pattern below the ship, and then records sound reflected from the sea floor through a set of narrow receivers aimed at different angles on either side of the ship. This system collects high resolution water-depth data that can distinguish differences of less than a meter. The system also measures the amount of sound energy returned from the sea floor (called backscatter), which can help identify different materials (such as rock, sand, or mud) on the sea floor. The multibeam system is coupled to a global positioning system (GPS) that can pinpoint sea-floor locations within one meter. All data are collected in digital form, which allows them to be processed by computer to produce maps, three dimensional models, or even fly-by videos that simulate a trip across the area being mapped in a high-speed submersible! Topographic maps are one of the most common outputs from these systems. On these maps, areas with the same depth are connected by lines, so that mountains (or valleys) are shown as a series of concentric, irregular closed curves. Curves that are close together indicate steep topography, while curves that are farther apart show more gentle slopes.

Learning Procedure

Note: Students will construct a three-dimensional model of the Patton Seamount by cutting out contours shown on Patton Seamount Bathymetry, and then stacking the contours together. Using 1/16-inch thick cardboard will produce the correct vertical scale when the illustration is enlarged 288%.

1. Explain that seamounts are the remains of underwater volcanoes, and that they are islands of productivity compared to the surrounding ocean environment. Describe the general process of seamount formation. You may need to review the concept of plate tectonics, if students are unfamiliar with this idea and the relevant terms. Discuss the need for accurate maps of seamounts in planning diving expeditions to explore them, and explain the general concept of multibeam swath bathymetry.

2. Give each group of students one enlarged copy of Patton Seamount Bathymetry and one piece of cardboard for each contour they are to construct. Have the students

glue the bathymetric images to the cardboard. Be sure to use enough glue to cover the entire surface of the cardboard.

3. Have each group carefully cut away all of the contours that are deeper than the contour they are constructing. If students are using X-Acto knives, be sure to have a suitable backing (heavy cardboard, cutting board, etc.) to protect work surfaces.

4. Starting with the deepest (largest) contour, carefully glue successive contours together to build the three-dimensional model of the seamount. Students working on shallower contours will have several pieces to glue in place.

5. Using the model the students have produced, discuss the advantages of various locations on the seamount for diving missions. Flat regions are more likely to have accumulations of sediment, and will provide different habitats than very steep areas. On the other hand, steep areas obviously have a greater range of depths within a short distance, so these are better sites to study how depth influences the distribution of various species. Identify areas that are likely to offer a variety of habitat types within a short distance. These offer some of the best opportunities to get the most out of limited diving time. You may want to show the video fly-around as part of this discussion, and compare images in the video to your own model.

6. Discuss the constructive and destructive forces that have shaped various parts of the Patton Seamount, and identify those that continue to operate. Have students predict how the seamount may change in the future, and what constructive and destructive forces are likely to cause these changes.

The Bridge Connection

www.vims.edu/bridge/geology.html

The "Me" Connection

Have students write a first-hand account of an exploratory dive on the Patton Seamount, describing features they see based on their model. You may want to assign different portions of the model to different students.

Connections to Other Subjects

English/Language Arts, Geography, Mathematics

Evaluation

Have students write a description of the Patton Seamount based on their model. Have them include geographic location (north-south-east-west directions and/or latitude and longitude), topography (steepness), and depth. Ask them to discuss the advantages and disadvantages of two-dimensional and three-dimensional topographic maps.

Extensions

Have students visit http://oceanexplorer.noaa.gov to keep up to date with the latest Gulf of Alaska Expedition discoveries.

Resources

http://oceanexplorer.noaa.gov - Follow the Gulf of

Alaska Expedition daily as documentaries and discoveries are posted each day for your classroom use. A wealth of information can be found at this site.

http://ridge.coas.oregonstate.edu/rkeller/seamounts.html - Background on seamount exploration and research in the Gulf of Alaska

http://geopubs.wr.usgs.gov/fact-sheet/fs013-00/fs013-00.pdf - Fact sheet on multi-beam mapping

http://newton.physics.wwu.edu:8082/jstewart/scied/earth.html - Earth science education resources

http://www.sciencegems.com/earth2.html - Science education resources

http://earth.leeds.ac.uk/dynamic earth - Background on plate tectonics

http://www-sci.lib.uci.edu/HSG/Ref.html - References on just about everything

National Science Education Standards

Content Standard A: Science as Inquiry

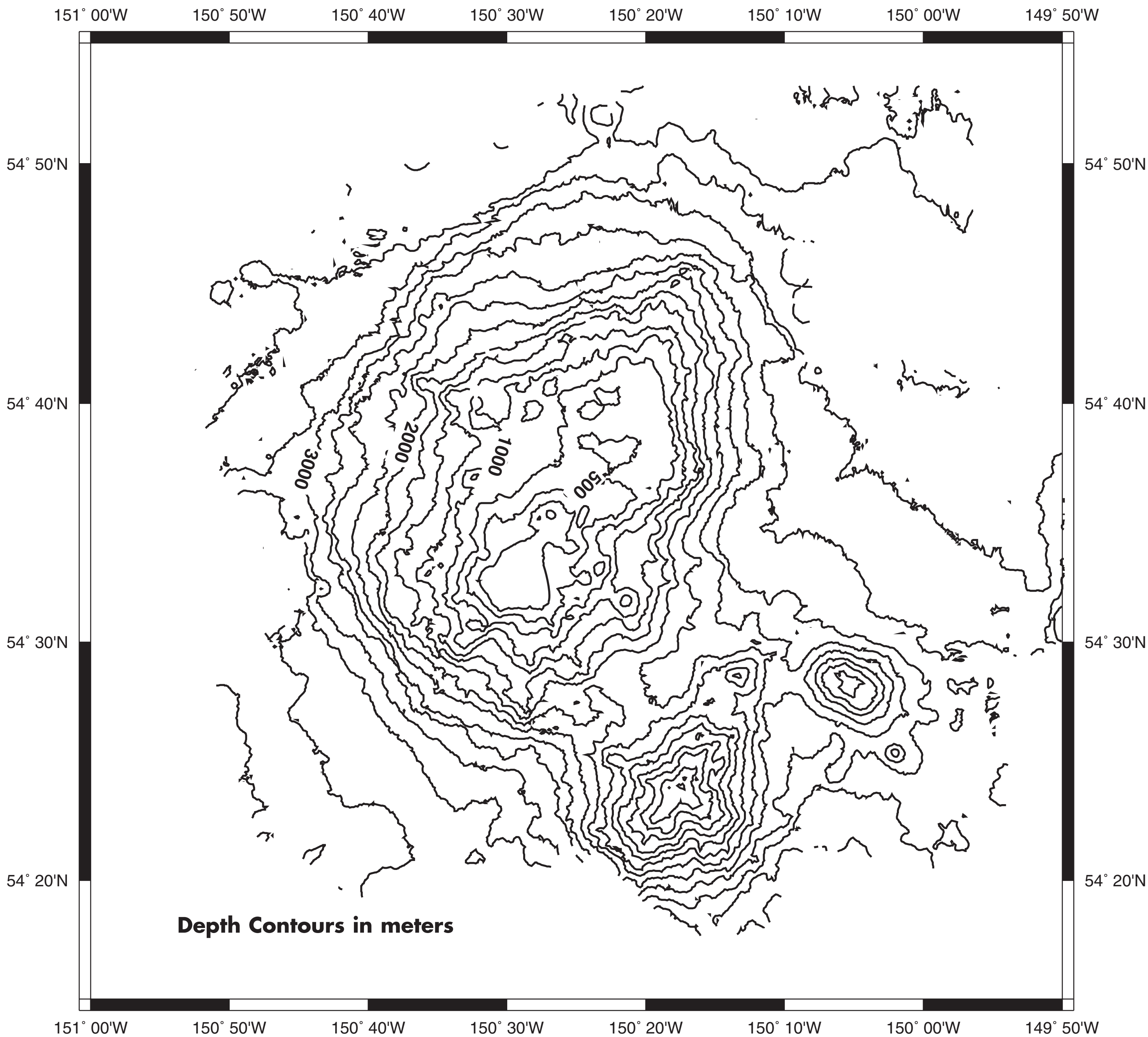
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard D: Earth and Space Science

- Structure of the Earth system

Student Sheet

File Patton150.grd - Bathymetry Grid



Alaska Sea Grant College Program
University of Alaska Fairbanks
http://www.uaf.edu/seagrant/NewsMedia/01ASJ/topo1.pdf